INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 25, No. 3, p. 137-157, 2024
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Contribution of beekeeping in socio-economic development of communities in Nyamagabe district: A case of beekeeping cooperatives around Nyungwe national park from 2020 to 2023

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Article published on September 10, 2024

Key words: Nyungwe national park, Socio-economic development, Beekeeping

Abstract

The study assesses the impact of beekeeping practices on the socio-economic development of communities in Nyamagabe District from 2020 to 2023. Using a descriptive research design, data were gathered through surveys, interviews, and online research to evaluate the influence of beekeeping on community welfare. The analysis highlights the crucial role of cooperatives, with findings showing a high level of involvement, and beekeeping's significant contributions to social integration, healthcare, and education. Government policies and NGOs play a vital role by providing technical assistance, fostering market access, and advocating for beekeeping-friendly policies. The findings show that beekeeping initiatives, supported by stakeholders, have enhanced community cohesion and promoted access to essential services. Regression analysis reveals a strong positive correlation between beekeeping practices, including hive management, market access, and training, and socio-economic development, with a correlation coefficient of 0.987. The study underscores the importance of collaboration between government agencies, NGOs, and other stakeholders in creating an enabling environment for beekeeping, which contributes to poverty alleviation, rural development, and environmental conservation. The study recommends further investment in training, technical assistance, and infrastructure, such as honey processing facilities and transport networks, to enhance market access and improve beekeepers' skills. These efforts would boost efficiency and productivity, maximizing the benefits of beekeeping for community development in the region.

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Introduction

The study on assessing the effects of beekeeping practices in the socio-economic development of communities in Nyamagabe District is motivated by the growing recognition of beekeeping as a sustainable livelihood option with significant socio-economic implications (FAO, 2020).

Beekeeping has been identified as a valuable tool for poverty alleviation, rural development, and environmental conservation, particularly in regions where natural resources are abundant, such as areas surrounding national parks (De la Fuente, 2020). Nyungwe National Park, located in Rwanda, boasts diverse flora and fauna, making it an ideal habitat for beekeeping activities. However, despite its potential, there is a paucity of research on the specific impact of beekeeping practices on the socio-economic development of communities adjacent to the park.

Nyungwe National Park, situated in Rwanda, is renowned for its rich biodiversity, including diverse floral resources that support thriving bee populations. This makes the area conducive to beekeeping activities, which have the potential to contribute significantly to the socio-economic well-being of surrounding communities (Tekeba, 2018). However, despite the ecological and economic importance of beekeeping in the region, there is a notable gap in empirical research examining its specific impacts on local livelihoods and community development.

The world total honey production is 1.3 million tons a year. High honey producing countries are Russia with 19333,000 tones, China with 161,000 tones and USA with 75 tones and Mexico with 67,000 tons a year. Developing countries produce about 47% of the total world's honey production. Ethiopia is the leading honey producer in Africa and 10th in the world, furthermore, before 1970s Mexico was the world's honey exporter but now China leads. Although several African countries are the major producers of honey, almost nothing is exported because of quality problem. Developing countries are taken as a group accounted for 55.5% total exports (Tekeba, 2018).

The Sub-Saharan Africa has a relatively lower honey production compared to its expected capacity (Amulen, 2017). This low contribution has been attributed to poor management practices and insufficient impact research activities, ineffective control of pests and diseases.

Beekeeping especially in East Africa is mostly carried out using traditional methods. In this method, beehives are made out of logs, bark, reeds, gourds and pots among other materials.

The activity is quite adaptable to various environments and conditions however farmers are unable to access better markets due to the poor quality and low quantity of honey produced. It may lead to bush fire due to use of fire during honey harvesting (USAID, 2016). In East Africa, Tanzania is the largest producer with 45,300 tons followed by Kenya with 7300 tons, then Uganda and Rwanda with just 4000 tons annually.

In Rwanda, the beekeeping industry has made major advances in the past 20 years, although production is still mainly low through traditional methods. The places including, Rusizi, Nyamasheke, Karongi, Nyamagabe, and Nyaruguru districts located near national parks are characterized by honey productivity which is ranging from 21MT to 30MT for honey (FAO, 2020). In this area, the honey production has increased and it consequently contributed to the improvement of rural incomes where each area can produce at least 500 tons of honey each year (Ntirenganya, 2019). There are about 35,000 known beekeepers in the country, some 90,000 modern beehives, and 200,000 traditional beehives. The main bee products exploited in Rwanda are honey, beeswax and propolis (used in medicines) and other products such as royal jelly, pollen, bee venom and bee brood (FAO, 2020).

Beekeeping provides nutritional, economic and ecological security to rural communities at the household level and is an additional income generating activity. Beekeeping contributes to food

security, poverty reduction and employment creation and income generation not only in the arid and semi-arid areas but in the majority of the Sub-Sahara Africa rural areas and requires little space and compliments other farm activities (Bett, 2017) and promising off-farm activities, which directly and indirectly contributes to smallholder's income in particular and economy in general (Tarekegn and Tegegne, 2017). Being a non-land-based activity; it does not compete with other resources demanding components of farming systems (Bukenya, 2018). Enormous agricultural and agro-based opportunities exist in the rural areas to generate income and employment. Understanding opportunities and drivers allows support organizations to align producers with market demand and capture value. While beekeepers share similar opportunities and drivers across regions of the world, local opportunities and gaps exist. Filling these gaps contributes to economic resilience for smallholder producers (Amulen, 2017).

Apiculture's value chain includes goods and services related to logging, milling, wood working, crafting hives, and providing pollinator services. It includes vendors, tailors, metallurgists, processors, and bottlers. Additionally, the market provides opportunities for producers of value-added products such as soaps, body butters, lotions, balms, bee pollen, royal jelly, propolis, infusions, meads, and other culinary goods. Service opportunities exist for trainers, extension agents, and technology developers that aid in hive and pest management, queen rearing. A major driver and opportunity for beekeepers exists in unmet demand for honey and pollination.

Untapped potential for pollination and honey exists in many countries (Amulen, 2017).

In terms of potential economic contribution of beekeeping have suggested that beekeeping is an environmentally friendly and non-farm business activity that has immense contribution to the economies of the society and to a national economy as whole. Beekeeping generates products with high market potential, while being more easily adapted to constraints of low credit and limited land access than other agricultural activities (Cristina and Donough, 2015).The general objective of this study was to assess the effects of beekeeping practices in socio-economic development of communities in Nyamagabe District for 2020-2023. It was guided by the following specific objectives:

1. To assess bee keeping practices levels of communities in Nyamagabe District;
2. To examine the socio-economic development of beekeepers in Nyamagabe District;
3. To determine a significant relationship between beekeeping practices and the level of socio-economic development in communities in Nyamagabe District.

Materials and methods

Theoretical framework

Development theory

Todaro and Smith (2003) define development as the "process of improving the quality of all human lives." They refer to three important aspects of development: Raising people's living levels-their incomes and consumption levels of food, medical services, education etc, through relevant economic growth; creating conditions conducive to the growth of people's "self-esteem" through establishment of social, and economic systems and institutions that promote human dignity and respect, and increasing people's freedom by enlarging the range of their choice variables, as by increasing varieties of consumer goods and services (Todaro and Smith, 2006). Development is defined as a holistic process aimed at improving the quality of human life through economic growth, social systems that promote dignity, and increased freedom of choice in consumer goods and services.

In the context of apiculture as a form of socio-economic development, beekeeping can offer significant opportunities for economic development while providing numerous livelihood benefits to national economies and local communities (Bett, 2017). Todaro and Smith's theory of development

emphasizes not only economic indicators like income and consumption levels but also the importance of social and institutional frameworks that enhance human dignity and freedom. This holistic approach provides a comprehensive framework for policymakers and communities to strive towards sustainable development goals. The theory posits that development encompasses not just economic growth but also social progress and individual freedom. It advocates for the establishment of institutions and systems that support these aspects, thereby creating conditions conducive to overall human development. Critics argue that Todaro and Smith's theory may oversimplify the complexities of development by focusing primarily on economic and social structures without adequately addressing cultural diversity and environmental sustainability. Additionally, the theory's emphasis on consumerism and economic growth as indicators of development has been challenged for its potential neglect of broader social and ecological impacts (Todaro and Smith, 2006).

Economic development theory

According to Sen (1983), economic development generally refers to the sustained, planned actions of policy makers and communities that promote the standards and economic health of a specific area. Economic development can also be referred to as the quantitative and qualitative changes in the economy. Such actions can involve multiple areas including development of human capital, infrastructure, regional competitiveness, environmental sustainability, social inclusion, health, safety, literacy, and other initiatives. Economic development differs from economic growth. Whereas economic development is a policy intervention endeavor with aims of economic and social well-being of people, economic growth is a phenomenon of market productivity and rise in GDP. Consequently, as economist Amartya Sen points out: “economic growth is one aspect of the process of economic development (Sen, 2014).

In the context of apiculture as a form of socio-economic development, in development theory, beekeeping can help economically vulnerable communities achieve economic stability. Honey production, pollination services, agriculture, and forestry are but a few of the economic benefits of beekeeping. Bee products such as propolis, royal jelly, beeswax, and bee venom are also high-value low-volume green products. In addition to the direct income from bee products, beekeeping generates off-farm employment opportunities in many fields including hive carpentry, honey trading, renting and hiring of bee colonies for pollination, and bee-based micro-enterprises. Economic development involves sustained, deliberate actions by policymakers and communities to improve economic standards and overall well-being through investments in human capital, infrastructure, and social inclusion.

Sen's theory distinguishes economic development from mere economic growth by highlighting the importance of inclusive policies that enhance capabilities and opportunities for all individuals. It underscores the multidimensional nature of development beyond GDP growth alone (Sen, 2014). Sen argues that economic development should prioritize enhancing human capabilities, ensuring social equity, and promoting environmental sustainability. This approach aims to create conditions where individuals have the freedom to lead fulfilling lives.

Critics contend that Sen's capabilities approach, while valuable in emphasizing human welfare, may be challenging to implement in practice due to its broad scope and the difficulty of quantifying capabilities. Additionally, some argue that the theory's focus on social factors and capabilities could overshadow the role of market mechanisms in driving economic progress (Sen, 2014). This theory defines well the topic of this research.

Sustainable development theory

Todaro and smith (2003) define sustainable development as a pattern of development that permits future generation to live at least as well as the current generation. This definition is the same as the

one provided by the World Commission on Environment and Development (WCED, 1987) sustainable development is development which meets the needs of the present without compromising the ability of the future generation to meet their own needs (Todaro and Smith, 2006).

Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges faced by humanity. As early as the 1970s, sustainability was employed to describe an economy "in equilibrium with basic ecological support systems. Ecologists have pointed to The Limits to Growth, and presented the alternative of an "economy “in order to address environmental concerns. The Framework assists with consideration of the various factors that constrain or enhance the livelihood of the household. The concept of sustainable development has in the past most often been broken out into three constituent parts: environmental sustainability, economic sustainability and sociopolitical sustainability. More recently, it has been suggested that a more consistent analytical breakdown is to distinguish four domains of economic, ecological, political, and cultural sustainability (Todaro and Smith, 2006).

In the context of apiculture as a form of socio-economic development, the understanding of sustainable livelihoods is separated into five parts: the vulnerability context; people’s livelihood assets; policies, institutions and processes; livelihood strategies, and livelihood outcomes.

Beekeeping is a useful means of strengthening livelihoods because it uses and creates a range of assets. Successful beekeeping draws upon all categories of capital assets. Beekeeping contributes in a balanced way to rural development efforts, leading to secure and sustainable livelihoods.

This supplementary model of development consists of five major elements: physical security, economic security, empowerment, social security, and conservation of resources. These elements are intricately linked and interdependent, which means they are all essential in order to achieve secure and sustainable livelihoods.

Sustainable development seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. It integrates environmental, economic, and social dimensions into development planning. The concept of sustainable development offers a framework for balancing economic growth with environmental preservation and social equity. It promotes long-term resilience by addressing intergenerational equity and environmental limits.

Sustainable development theory posits that development strategies should consider the interconnectedness of ecological, economic, and social systems. It advocates for policies and practices that minimize environmental degradation while promoting equitable economic growth and social well-being. Critics argue that the concept of sustainable development can be vague and difficult to operationalize, leading to challenges in prioritizing and implementing policies that balance economic, environmental, and social goals effectively. There are also concerns that the theory's emphasis on sustainability may sometimes conflict with short-term economic priorities and development aspirations of countries (Todaro and Smith, 2006).

The capability approach theory

The Capability Approach, spearheaded by Amartya Sen and further refined by scholars like Martha Nussbaum, proposes a shift in development paradigms from mere economic growth to assessing individuals’ capabilities and freedoms. Introduced in the 1980s, this theory contends that development should not solely rely on economic indicators but should also consider people's ability to lead lives they value. It assumes that individuals have varying abilities, resources, and opportunities, advocating for policies that enhance their capabilities and freedoms to pursue their well-being. However, it has faced criticism for its abstract nature and challenges in

measurement (Sen, 2014).In the context of apiculture as a form of socio-economic development, the Capability Approach offers a valuable lens to evaluate its impact beyond economic outcomes. Rather than solely focusing on honey production or income generation, this perspective highlights how beekeeping can empower individuals by providing opportunities to acquire new skills, generate income, improve nutrition through honey consumption, and contribute to environmental sustainability. By adopting a capability perspective, policymakers and practitioners can design interventions that enhance beekeepers' overall well-being, fostering more holistic and sustainable development in apiculture.

In summary, the capability approach is the most theory that must be adopted because it entails two normative claims; the claim that the freedom to achieve well-being is of primary moral importance and secondly that well-being should be understood in terms of people's capabilities and functioning. Within philosophy ethics, the capability approach has been employed to the development of several conceptual and normative theories within, most prominently, development ethics, political philosophy, public health, education, environment ethics which is found in the current study in dependent variables (social, Health, education, income, job opportunities). It links beekeeping practices and socio-economic development.

Conceptual framework

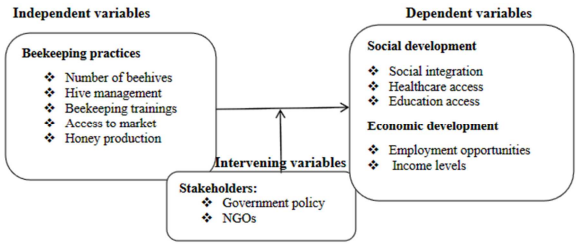

Fig. 1. Conceptual framework

Research design

The study focused on mixed methods design type. It is defined as statically study to identify patterns or trends in a situation, and also establish causal as linkage among its different elements. Descriptive research is not only for the quantitative studies but instead it can utilize elements of both the quantitative and qualitative studies which means the researcher has used the mixed methods.

Total population

Target population refers to the total of items about which information is desired. The research population is also referred to as a large collection of individuals or objects that is the main focus of a scientific query. It is for the benefit of the population that researches are done. The target population of this study was 466 which are grouped into six (6) cooperatives (Table 1).

Table 1. Total population

Number	Cooperative	Number of people
1	KOASEKI	22
2	CODAPE	133
3	KUAGA	52
4	Uruyange rwa Buruhukiro	17
5	Intimirwa	222
6	Abakundanzuki Nkomane	20
	Total=	466

Sample size

A sample as a smaller group or sub-group obtained from the accessible population. Empirically supported generalizations are usually based on partial information. This is the case because often it is impossible, impractical, or extremely expensive to collect data from all units of analysis encompassed in the research problem. Since a researcher cannot feasibly conduct research on an entire population, particularly if the population is too large, using a sample to represent the population is the most desirable scientific way of representing a population in a study. The sample size for this study was obtained scientifically using the Slovin's formula that yields a representative sample that accommodates the sampling error of selection (Table 2).

Where:

$$n = \frac{N}{1 + N(e)^2}$$

n = Sample Size;

N = Target Population;

e = Sampling Error (5%)

Hence,

$$n = \frac{466}{1+466(0.05)^2} = 215$$

Table 2. Sample size distribution

Names of cooperative	Number of populations	Sample size
KOASEKI	22	$\frac{215*22}{466} = 10$
CODAPE	133	$\frac{215*133}{466} = 61$
KUAGA	52	$\frac{215*52}{466} = 24$
Uruyange rwa Buruhukiro	17	$\frac{215*17}{466} = 8$
Intimirwa	222	$\frac{215*222}{466} = 103$
Abakundanzuki Nkomane	20	$\frac{215*20}{466} = 9$
Total	466	215

Sampling technique

Sampling technique is defined as the way in which a group of potential respondents are selected as part of a sample size upon which a study is conducted. The study used stratified random sampling, simple random and purposive sampling methods.

Stratified random sampling technique

Stratified random sampling involves first dividing a population into subpopulation and then applying random sampling method to each sub population to form a test group. This has been applied on different cooperatives of beekeepers of Nyamagabe District lies on Nyungwe National Park.

Simple random sampling

In simple random sampling method, everyone had an equal chance to be selected in the sample. The researcher expected to reach the beekeepers grouped in the cooperative by choosing the respondents in stratified random method by writing "yes" on the papers which is equal to the sample size and "no" for the remaining participants.

Purposive sampling technique

In purposive sampling technique, the researcher has chosen the important person who could provide tangible information in formal way. It is in this perspective the researcher has been selected six (6) cooperatives which lies on Nyungwe National Park and the leaders (7) in charge of those activities.

Instruments of data collection

Questionnaire

The study of Carl *et al.* (2011) defined questionnaire as a set of questions designed to generate the data necessary for accomplishing the objectives of the research project, or it's a set of questions which must be answered by the respondents in writing. The researcher distributed 215 likert skales questionnaires for beekeepers for the means for quantitative analysis (Carl and Kenneth, 2011).

Interview

Qualitative in-depth interviews were conducted in beekeeping cooperatives lying on Nyamagabe District. Empirical data will be mainly gathered through personal interviewing, which implies that the researcher will have contact with respondents participating in this study. During interviews, the researcher will spend sufficient time to enable regular interactions with respondents. Therefore, the main data collection method will be qualitative interviews conducted in Kinyarwanda language. The researcher interviewed seven (7) leaders: One Community Liaison Officer/Nyungwe Management Company, One District cooperative Officer and five Animal resource officers from 5 targeted Sectors.

Results and discussion

Identification of respondents

In this study, the respondents were 215 respondents selected from beekeeping cooperatives in Nyamagabe District and they are identified in a different way by their groups of age, gender, working experience, qualification and religious. The findings provided were presented in the following tables thereafter.

The presentation in the Table 3 shows that among respondents of beekeeping cooperatives at 66.5% were male while at 33.5% was female. These findings are completed by the work of Hart (2017) which confirmed that the part of gender consideration cannot not to be ignored apart from

they form one family, also they work jointly to provide the constructive information where it is required. The findings prove that the number of males is dominant but the grouping together male and female offer the constructive effort toward the Contribution of beekeeping in socio-economic development of communities around Nyungwe National Park.

Table 3. Distribution of respondents by gender

Gender	Respondents	Percentage
Male	143	66.5
Female	72	33.5
Total	215	100

Presentation of findings

This presentation section explores the insights gathered directly from the people involved in beekeeping cooperatives in Nyamagabe District, illuminating their experiences and perspectives on how beekeeping practices contributes to the socio-economic development of communities surrounding Nyungwe National Park. By considering their responses, this section uncovers the real-life impacts of beekeeping practices on income generation, environmental conservation, and community cohesion. Through these firsthand accounts, the section aims to better understand the significance of beekeeping as a catalyst for positive change in the region. The findings are presented according to the research specific objectives.

Descriptive statistics of beekeeping practices impacts on socio-economics development of beekeeping cooperatives

This section seeks to provide an overview of the descriptive statistics that illuminate the contribution of beekeeping to the socio-economic development of communities around Nyungwe National Park, with a focus on beekeeping cooperatives in Nyamagabe District. By analyzing key metrics and indicators, the section also aims to understand the multifaceted impacts of beekeeping on the livelihoods, income generation, and social integration of community members in this ecologically significant region.

Descriptive statistics serve as a powerful tool for summarizing and interpreting data, allowing uncovering patterns, trends, and associations within the dataset. Through an exploration of various descriptive measures, including measures of central tendency, dispersion, and distribution (Mellon, 2020), the section can gain valuable insights into the socio-economic dynamics of beekeeping activities within the study area.

The descriptive statistics presented in this analysis shed light on diverse aspects of beekeeping cooperatives, including hive management, market access, training participation, income generation, production levels and socio-economic development in the communities surrounding Nyungwe National Park.

This section also provides the specific descriptive statistics collected from beekeeping cooperatives in Nyamagabe District, providing a comprehensive overview of their contributions to socio-economic development and highlighting actionable insights for fostering sustainable beekeeping practices and inclusive growth in the region. The respondents were asked to shows their views among different statements related on different statements provided using Likert scale. Mean and standard deviation parameters were used to rank the issue, where mean represents the average score given by respondents for each statement and the standard deviation measures the extent of variability or dispersion of scores around the mean.

Beekeeping practices of communities around Nyungwe national park

This section examines descriptive statistics regarding objective one of the research projects pertaining to beekeeping practices and their influence on socio-economic development. Through a concise analysis of key data points, this section aims to provide a clear picture of how beekeeping initiatives impact various aspects of community prosperity. By exploring these statistics, findings gain valuable insights into the relationship between beekeeping practices and socio-

economic well-being, offering a foundation for informed decision-making and future development strategies.

The Table 4 presents descriptive statistics for various aspects of hive management practices based on responses from cooperative beekeepers. Each aspect is assessed on a scale ranging from 1 to 5, with higher scores indicating stronger acknowledgment of that aspect. The data from 215 respondents highlight the perceived level and importance of cooperative involvement in various aspects of hive management. Across all categories, respondents consistently rated cooperative support highly. The mean ratings suggest that cooperatives play a significant role in ensuring the health and well-being of bee colonies. Specifically, respondents rated that the cooperatives support the provision of regular hive inspections at mean of 4.00 and Standard deviation of 1.015, indicating its crucial role in preventing pest infestations and diseases. Supplementary the respondents show that feeding of bees received a slightly higher mean rating of 4.06 and standard deviation of 1.026, emphasizing its contribution to colony growth and health enhancement. Moreover, respondents highly valued proper ventilation and hive spacing provided by cooperative management, as indicated by the mean rating of 4.07 and standard deviation of 0.000, underlining its essential role in maintaining overall colony well-being.

Table 4. Descriptive statistics regarding beekeeping practices on cooperatives' hive management

Statements	Mean	Std. deviation	Mean description
Cooperative provide regular hive inspections.	4.00	±1.015	Strong mean
Cooperative give supplementary feeding of bees.	4.06	±1.026	Strong mean
Cooperative do the proper ventilation and hive spacing.	4.07	.000	Strong mean
Cooperative provide regular cleaning and maintenance of beekeeping equipment and hive components.	4.05	±1.000	Strong mean

Additionally, the respondents showed that the provision of regular cleaning and maintenance of beekeeping equipment and hive components provided by the cooperative was deemed crucial for efficient hive management, with a mean rating of 4.05 and standard deviation of 1.000. These statistics highlight the pivotal role that beekeeping cooperatives play in supporting beekeepers and ensuring the success and sustainability of beekeeping ventures in Nyamagabe District.

These findings are supported by "animal resource officer" when asked how they support the initiatives aimed at increasing the number of beehives within the community, and what strategies they employ to encourage beekeepers to expand their apiaries. He answered that as an animal resource officer, supporting initiatives to boost the number of beehives in the community involves a multifaceted approach like prioritize regular hive inspections, recognizing their critical role in maintaining healthy bee colonies by promptly identifying and addressing pest infestations and diseases. Advocate for supplementary feeding of bees when necessary, understanding its importance in promoting colony growth and vitality, especially during periods of food scarcity. Moreover, the researcher emphasizes the significance of proper ventilation and hive spacing, as these factors significantly contribute to the overall well-being of bee colonies, ensuring optimal conditions for their development and productivity. I also emphasize the importance of regular cleaning and maintenance of beekeeping equipment and hive components, essential practices that facilitate efficient hive management and help mitigate potential health risks to the bees. Through these strategies, I aim to provide comprehensive support to beekeepers, fostering a conducive environment for the expansion of apiaries and the flourishing of bee populations within the community. These findings also are in the same line with the ones of (Jones, 2022) in the journal of Hive Management Practices and Their Impact on Bee Colony Health: Insights from a Survey of Beekeepers which stated that the effective hive management practices play a pivotal role in sustaining thriving bee colonies and

the good hive management strategies ensure the success and sustainability of beekeeping endeavors.

The Table 5 shows the descriptive statistics from 215 respondents that shed light on the perceived level and importance of cooperative support in facilitating market access for beekeepers. Across all categories, respondents consistently rated cooperative involvement highly, indicating its crucial role in ensuring the profitability and sustainability of beekeeping ventures. Specifically, respondents rated the presence of reliable channels for selling bee products at mean of 4.06 and standard deviation of 0.000, emphasizing the significance of this support in sustaining profitable beekeeping operations. Additionally, the results from the respondents showed the access to both local and international markets received a high mean rating of 4.05 and standard deviation of 1.000, highlighting the importance of diversifying customer bases and increasing sales opportunities. Moreover, respondents valued the use of online platforms for advertising performed by the cooperatives, with a mean rating of 4.02 and standard deviation of 1.068, indicating its role in enhancing beekeepers' visibility and market reach. Furthermore, attendance at exhibitions aimed at promoting bee products was also deemed valuable, with a mean rating of 4.01 and standard deviation of 1.000, suggesting its significant contribution to facilitating market access for beekeepers. These statistics underscore the pivotal role that cooperatives play in supporting beekeepers and ensuring their success in accessing markets.

Table 5. Descriptive statistics regarding beekeeping practices on access to market

Statements	Mean	Std. Deviation	Mean description
Cooperative have reliable channels for selling bee products (honey, beeswax, etc.).	4.06	.000	Strong mean
Cooperative have access to local and international markets.	4.05	±1.000	Strong mean
Cooperative use online platforms.	4.02	±1.068	Strong mean
Cooperative attend the exhibition aimed at promoting bee products and honey.	4.01	±1.000	Strong mean

The findings are supported by "District Cooperative Officer", when asked how they improve the access to markets for beekeepers in the community and the specific initiatives or partnerships used at connecting beekeepers with potential buyers or markets for their bee products. He said that they prioritize initiatives for improving market access for beekeepers in the community by establishing reliable channels for selling bee products such as honey and beeswax, he said also they facilitate access to both local and international markets, enabling beekeepers to diversify their customer base and expand sales opportunities. He said also that they organize exhibitions specifically aimed at promoting bee products and honey, providing beekeepers with valuable opportunities to showcase their products and connect with potential buyers.

The above findings are supported by the research of (Brown and James, 2023) that stated that the achievement success in beekeeping ventures hinges significantly on access to viable markets for bee products.

The Table 6 showed the descriptive statistics that derived from the responses of 215 beekeepers underscore the level of training that being provided by the cooperatives and the significant role of beekeeping training in enhancing beekeepers' knowledge and skills. The high mean ratings across all categories indicate the perceived level and importance of attending beekeeping trainings. Specifically, beekeepers highly showed that they get trainings and valued the opportunity they get to improve their understanding of bee behavior and hive management techniques, as indicated by the mean rating of 4.07 and standard deviation of 1.000. Moreover, practical hands-on experience provided to the beekeepers during the trainings is deemed essential for developing their effective beekeeping

skills, with a mean rating of 4.02 and standard deviation of 0.000. Additionally, the respondents showed that they get the comprehensive coverage of various topics, including hive construction, honey extraction, and pest management, and are recognized as valuable, with a mean rating of 4.16 and standard deviation of 1.020.

Furthermore, the provision of continuing education opportunities, such as advanced workshops, for experienced beekeepers to enhance their marketing skills is also highly applied and valued, as indicated by the mean rating of 4.00 and standard deviation of 0.012. These statistics highlight the crucial application and role of beekeeping training programs in equipping beekeepers with the necessary knowledge and skills for successful beekeeping endeavors. The findings above are in the same with the one of (Allison and Joseph, 2013) that state that Beekeeping training serves as a cornerstone for achieving good production outcomes in beekeeping functions. The study says that the beekeeping training fostering successful production practices and beekeepers recognize that attending beekeeping trainings substantially improves their understanding of bee behavior and hive management techniques, as per practical hands-on experience provided during the trainings is crucial for developing effective beekeeping skills, particularly in honey processing, the continuing education opportunities, such as advanced workshops, enables experienced beekeepers to further refine their skills and stay updated with the latest practices, ultimately enhancing production efficiency.

Table 6. Descriptive statistics regarding beekeeping practices on beekeeping training

Statements	Mean	Std. Deviation	Mean description
Beekeepers attend beekeeping trainings.	4.07	±1.000	Strong mean
Beekeepers get practical hands-on experience provided during beekeeping trainings.	4.02	.000	Strong mean
Beekeeping trainings cover a wide range of topics, including hive construction, honey extraction and pest management.	4.16	±1.020	Strong mean
Cooperative provides the continuing education opportunities, such as advanced beekeeping workshops.	4.00	.000	Strong mean

The findings are supported by "Animal Resource Officer", who said that the government facilitates beekeeping trainings for community members to enhance their beekeeping skills effectively and these trainings cover various topics crucial for successful beekeeping, including bee behavior, hive management techniques, and hive construction, honey extraction methods, and pest management. He said also that practical hands-on experience is emphasized during the trainings, providing participants with valuable hands-on training in honey processing and other essential tasks. He said also that continuing education opportunities such as advanced workshops are offered to experienced beekeepers, focusing on topics like marketing strategies to further enhance their knowledge and skills.

Research of (Jonas, 2014) are in the same line with the statements where it says that by ensuring a comprehensive trainings and hands-on experience in beekeeping's community equip community members with the necessary skills and knowledge to engage in successful beekeeping ventures.

The Table 7 provides valuable insights into the perceptions of 215 respondents regarding the role of stakeholders, particularly government policies, in fostering beekeeping activities and enhancing the sector's productivity, profitability, and sustainability. Firstly, respondents highlight the crucial importance of government policies in supporting and promoting beekeeping activities, particularly through exhibitions, with a mean rating of 4.10 and standard deviation of 1.057. This underscores the recognition of government initiatives as instrumental in providing platforms for beekeepers to showcase their products and exchange knowledge and experiences. Secondly, while respondents acknowledge the role of

government policies in facilitating access to honey and by-product markets, the mean rating of 3.80 and standard deviation of 1.000 suggests a need for further improvement in this area. Additionally, collaboration among government agencies, beekeeping associations, and other stakeholders is deemed essential for developing effective policies that enhance the capacity building of cooperative administration, as indicated by the mean rating of 4.10 and standard deviation of 1.059. Lastly, government investment in research and development for beekeeping technology and practices is seen as critical for increasing productivity, profitability, and environmental sustainability within the sector, with a mean rating of 4.05 and standard deviation of 1.001. These findings underscore the pivotal role of stakeholders, particularly government policies, in shaping the beekeeping industry and fostering its growth and sustainability.

Table 7. Descriptive statistics regarding stakeholders of beekeeping's practices related to government policies

Policies	Mean	Std. Deviation	Mean description
Government policies support and promote beekeeping activity.	4.10	±1.057	Strong mean
Government policies help beekeepers to find honey and by products market	3.80	±1.000	Average mean
Collaboration between government agencies, beekeeping associations, and other stakeholders is crucial for developing effective policies.	4.10	±1.059	Strong mean
Government investment in research and development for beekeeping technology and practices enhances productivity, profitability, and environmental sustainability.	4.05	.000	Strong mean

The findings are supported by "District Cooperative Officer", who said they put efforts in coordinating, supporting and promote beekeeping activities within the community through various strategies like advocate for government policies that prioritize and facilitate beekeeping exhibition activities, recognizing their importance in showcasing the sector's potential and fostering growth. He said that they ensure that government policies support beekeepers in finding markets for honey and byproducts, enhancing their economic opportunities. He explained that the collaboration between government agencies, beekeeping associations, and stakeholders is crucial for developing effective policies that improve capacity building and cooperative administration. He also said that they advocate for government investment in research and development for beekeeping technology and practices to enhance productivity, profitability, and environmental sustainability within the sector.

The findings are supported by the study of (Gohr, 2012) which stated that Government policies play a significant role in shaping the beekeeping industry, ensuring the sustainability of bee populations, promoting pollination services, and safeguarding environmental health.

The study of Emerson (2019) stated that Government agencies such as the Department of Agriculture or Environmental Protection Agency enact regulations to oversee beekeeping practices. Develop and enforce standards for hive management, disease control, and pesticide use to ensure bee health and food safety. The study reveals that collaborate with beekeepers, researchers, and other stakeholders formulate evidence-based policies that address emerging challenges and opportunities in the beekeeping sector. Government policies on beekeeping are shaped by the input and collaboration of various stakeholders, reflecting a balance between economic, environmental, and social interests.

Effective policies promote the resilience and sustainability of beekeeping cooperatives and enterprises while safeguarding the vital role of bees in ecosystems and food production systems.

The Table 8 presents descriptive statistics summarizing respondents' perceptions of the role of Non-Governmental Organizations (NGOs) as stakeholders in the context of beekeeping. The mean represents the average score given by respondents for each statement regarding the role of NGOs in

beekeeping. For the statement "NGOs play a crucial role in providing technical assistance and training programs to beekeepers", the mean score of 3.08 and standard deviation of 1.000 indicates that, on average, respondents perceive NGOs to have a moderately significant role in this aspect of beekeeping support. Similarly, the respondents showed for the statement "NGOs contribute to the promotion of beekeeping as a tool for poverty alleviation and rural development", the mean score of 3.14 and standard deviation of 1.000 suggests a slightly higher perceived significance compared to the previous statement. The statement "NGOs facilitate beekeepers to find infrastructures and transportation" has the highest mean score of 4.05 and standard deviation of 1.000, indicating that respondents perceive NGOs to have a significant role in facilitating infrastructure and transportation needs for beekeepers.

The statement "NGOs play a pivotal role in advocating for beekeeping-friendly policies and regulations" also received a high mean score of 4.00 and standard deviation of 1.040, indicating that respondents perceive NGOs to have a crucial role in advocacy for beekeeping-friendly policies.

Table 8. Descriptive statistics regarding non-government organizations stakeholders

Statements	Mean	Std. Deviation	Mean description
NGOs play a crucial role in providing technical assistance and training programs to beekeepers.	3.08	±1.000	Average mean
NGOs contribute to the promotion of beekeeping.	3.14	±1.000	Average mean
NGOs facilitate beekeepers to find infrastructures and transportation	4.05	±1.040	Strong mean
NGOs play a pivotal role in advocating for beekeeping-friendly policies and regulations.	4.00	±1.000	Strong mean

Generally, the data showed that respondents generally perceive NGOs to play important and diverse roles in supporting beekeeping, ranging from providing technical assistance and training to advocating for favorable policies and facilitating infrastructure needs in Nyamagabe District.

The findings are supported by "District Cooperative Officer", who said they collaborate with NGOs to provide technical assistance, training programs, and infrastructure support to beekeepers, thereby enhancing their capacity and productivity. NGOs also help in advocating for beekeeping-friendly policies and regulations, ensuring the protection of beekeepers' rights and the sustainable management of bee populations. Through these efforts, they aim to foster a conducive environment for beekeeping as a tool for poverty alleviation, rural development, and environmental conservation.

A research study conducted by (Smith, 2020) is supporting the findings where it investigated the role of collaborative partnerships between governmental agencies such as District Cooperative Officers and non-governmental organizations (NGOs) in promoting sustainable beekeeping practices. The study found that District Cooperative Officers collaborate with NGOs to provide technical assistance, training programs, and infrastructure support to beekeepers, which enhances their capacity and productivity. Furthermore, the research highlighted that NGOs play a crucial role in advocating for beekeeping-friendly policies and regulations, ensuring the protection of beekeepers' rights and the sustainable management of bee populations. These collaborative efforts were shown to foster a conducive environment for beekeeping as a tool for poverty alleviation, rural development, and environmental conservation, as evidenced by the insights provided by the District Cooperative Officer.

Examine the socio-economic development of beekeepers around Nyungwe national park

This section delves into descriptive statistics of objective two of the research projects focusing on the socio-economic development of beekeeping cooperatives. These statistics offer a snapshot of the key indicators shaping the economic and social landscape of the beekeeping cooperatives. By

examining data such as income generation, employment opportunities, and community engagement, the section provide valuable insights into the impact of beekeeping initiatives on local prosperity. Through a concise analysis of these descriptive statistics, the section aims to highlight the achievements of beekeeping cooperatives, providing a basis for understanding their role in driving sustainable socio-economic development within their communities.

Table 9. Descriptive statistics regarding social integration of the beekeeping cooperatives

Statements	Mean	Std. deviation	Mean description
Social Integration			
Engaging in beekeeping fosters community cohesion and collaboration among beekeepers.	4.12	±1.001	Strong mean
Beekeeping increases gender equality in the daily life of cooperative.	4.06	±1.075	Strong mean
Once there is a need of social contribution (marriage, funeral, birthdays, leisure,) a beekeeper can participate.	4.10	±1.035	Strong mean
Incorporating beekeeping into social development projects enhances resilience and livelihood opportunities, particularly in rural areas.	3.54	±1.074	Average mean

Table 10. Descriptive statistics regarding health access of the beekeeping cooperatives

Statements	Mean	Std. Deviation	Mean description
Healthcare access			
Beekeeping income led to have money to buy nutritious food.	4.00	±1.008	Strong mean
Income generated from beekeeping projects can be used to buy materials for hygiene and sanitation at home.	4.03	.000	Strong mean
Educating communities about the medicinal properties of bee products encourages self-care practices and reduces reliance on expensive pharmaceuticals.	4.02	±1.025	Strong mean
By generating income and economic opportunities, beekeeping enhances communities' ability to afford healthcare services, medications and health insurance.	4.06	±1.000	Strong mean

The Table 9 provides detailed insights into the various ways in which beekeeping contributes to social integration as perceived by 215 respondents from the beekeeping cooperatives in Nyamagabe District. Firstly, under the category of social integration, Respondents agree that beekeeping is recognized for fostering community cohesion and collaboration among beekeepers, thereby strengthening social networks and reducing loneliness (mean rating: 4.12, SD: 1.001). Furthermore, respondents agree that beekeeping is acknowledged for its role in promoting gender equality within cooperatives (mean rating: 4.06, SD: 1.075) and facilitating participation in social contributions such as marriages, funerals, and leisure activities (mean rating: 4.10, SD: 1.035). Additionally, the respondents agree that the integration of beekeeping into social development projects is seen as enhancing resilience and livelihood opportunities, particularly in rural areas (mean rating: 3.54, SD: 1.074).

The Table 10 provides results in terms of healthcare Access, respondents agree that beekeeping income is noted for its role in enabling individuals to afford nutritious food and materials for hygiene and sanitation at home (mean rating: 4.00, SD: 1.008). Moreover, respondents confirm that educating communities about the medicinal properties of bee products is recognized for promoting self-care practices and reducing reliance on expensive pharmaceuticals (mean rating: 4.03, SD: 0.000). Additionally, respondents agreed that beekeeping is seen as enhancing communities' ability to afford healthcare services, medications, and health insurance through income generation and economic opportunities (mean rating: 4.06, SD: 1.025).

Table 11. Descriptive statistics regarding education access of the beekeeping cooperatives

Statements	Mean	Std. deviation	Mean description
Education access			
Income generated from beekeeping activities can support educational expenses such as school fees, books, and uniforms.	3.44	±1.078	Average mean
Beekeeping initiatives provide vocational training and skills development opportunities, particularly for youth.	3.86	±1.000	Average mean
Revenue from beekeeping can be invested in community educational initiatives, such as scholarships, after-school programs, and educational infrastructure improvements.	3.94	±1.000	Average mean
Establishing beekeeping cooperatives or clubs in schools promotes teamwork and reduce school dropout.	4.07	.000	Strong mean

The Table 11 provides results in the realm of education access, respondents agreed that income from beekeeping activities is acknowledged for supporting their educational expenses such as school fees, books, and uniforms, thus enhancing access to education for children in the community (mean rating: 3.44, SD: 1.000). Furthermore, respondents agree that beekeeping initiatives provide vocational training and skills development opportunities, particularly for youth, contributing to improved access to education (mean rating: 3.86, SD: 1.000). Additionally, respondents agreed that revenue from beekeeping can be invested in community educational initiatives, such as scholarships and educational infrastructure improvements (mean rating: 3.94). Moreover, establishing beekeeping cooperatives or clubs in schools is seen as promoting teamwork and reducing school dropout rates (mean rating: 4.07, SD: 0.000).

Overall, the findings presented in the tables above reveal the multifaceted positive contributions of beekeeping to social development, healthcare access, and education access. These findings underscore the significant role of beekeeping in promoting social development, improving healthcare access, and enhancing education access within beekeepers' communities in Nyamagabe district.

When asked about beekeeping's cooperative social development, "Community Liaison Officer" said that they promote social integration through beekeeping initiatives by fostering inclusive participation and empowering marginalized groups or vulnerable individuals within the community. Efforts are made to ensure that everyone, regardless of their background, has access to beekeeping activities. This includes providing training and resources in beekeeping skills, hive management, and honey processing to empower individuals from marginalized groups. He also said that partnerships with local healthcare and educational institutions are forged to ensure access to healthcare services and educational opportunities for participants.

By creating a supportive environment that values diversity and inclusivity, beekeeping initiatives serve as a platform for social integration, enabling community members to come together, learn from each other, and collectively thrive.

The findings are supported by the research of (Jameson, 2019) that stated that beekeeping industries plays a significant role in fostering social development in various ways by promoting community relationship and collaboration among beekeepers, leading to stronger social networks. By working together towards common goals such as hive maintenance and honey harvesting, beekeepers develop a sense of camaraderie and mutual support, which enhances community bonds. The research stated also that beekeeping often involves collective efforts in social contributions such as celebrations, ceremonies, and community events, further strengthening social ties within the community. Furthermore, integrating beekeeping into social development projects enhance resilience and livelihood opportunities, particularly in rural areas where beekeeping can provide sustainable income sources and promote social and economic

empowerment. Beekeeping serves as a catalyst for social integration, gender equality, community engagement, and economic development, thereby contributing significantly to overall social development.

Increased income through beekeeping empowers individuals and communities economically, leading to better health and social outcomes. Studies have shown that economic empowerment leads to improved health access and outcomes (Marmot, 2002).

Beekeeping provides a sustainable source of income, which is crucial for long-term health and well-being. Sustainable livelihoods reduce vulnerability and improve resilience, which are essential for maintaining health (Bradbear, 2009).

Education about the benefits of bee products and improved financial resources from beekeeping can lead to better health practices and reduced healthcare costs. Community health education is vital for promoting preventive health measures (Bogdanov, 2012; Viuda-Martos *et al.*, 2008).

These ideas and references provide strong support for the positive impact of beekeeping income on health access, as reflected in the descriptive statistics presented in the table.

Table 12. Descriptive statistics regarding economic development on employment opportunity

Statements on employment opportunity	Mean	Std. deviation	Mean description
Expansion of beekeeping activities creates job opportunities in hive management, honey extraction, marketing, and value-added product development.	3.76	±1.065	Average mean
Training programs in beekeeping provide individuals with valuable skills that can lead to employment in the apiculture industry.	3.84	±1.000	Average mean
The growth of beekeeping enterprises stimulates local economies by generating income for beekeepers in job opportunities in sales, distribution, and branding	3.98	±1.006	Average mean
Government support and investment in beekeeping infrastructure and marketing initiatives.	4.05	.000	Strong mean

The Table 12 provides insights into the impact of beekeeping in generating employment opportunities and contributing to economic development, based on responses from 215 participants. Firstly, the respondents agreed that the expansion of beekeeping activities is recognized for its potential to create job opportunities across various sectors such as hive management, honey extraction, marketing, and value-added product development (mean rating: 3.76, SD: 1.065). Secondly, the respondents agreed that the training programs in beekeeping are highlighted as valuable avenues for equipping individuals with the necessary skills for employment in the apiculture industry, further contributing to job creation (mean rating: 3.84, SD: 1.000). Moreover, the respondents agreed that the growth of beekeeping enterprises is acknowledged for stimulating local economies by generating income for beekeepers and providing job opportunities in sales, distribution, and branding (mean rating: 3.98, SD: 1.005).

Additionally, the respondents agreed that the government support and investment in beekeeping infrastructure and marketing initiatives are seen as crucial drivers for catalyzing job creation and economic growth, particularly in rural and urban areas (mean rating: 4.05, SD: 1.000). These findings underscore the multifaceted impact of beekeeping in promoting employment opportunities and fostering economic development at both local and national levels.

The findings are supported by "District Cooperative Officer", who said that the government supports the creation of employment opportunities through beekeeping projects within the community by

fostering the expansion of apiculture-related activities. This includes roles in hive management, honey extraction, marketing, and value-added product development, all of which contribute to job creation. Through training programs in beekeeping, individuals acquire valuable skills that can lead to employment in the apiculture industry, stimulating local economies and generating income for beekeepers. Government support and investment in beekeeping infrastructure and marketing initiatives further catalyze job creation and economic growth in both rural and urban areas. By promoting beekeeping as a viable livelihood option, the government plays a crucial role in enhancing employment opportunities and fostering sustainable development within the community.

The study of (Peter and Jeff, 2013) supporting the above findings where they stated that beekeeping industries especially in rural communities has a significant impact on economic development by creating job opportunities in various sectors related to apiculture. The expansion of beekeeping activities leads to job creation in hive management, honey extraction, marketing, and the development of value-added products. These activities require skilled labor and management, thereby providing employment opportunities for individuals within the community. The training programs in beekeeping play a crucial role in equipping individuals with the necessary skills to enter the apiculture industry, further expanding the pool of qualified workers and enhancing job prospects. Moreover, the growth of beekeeping enterprises stimulates local economies by generating income for beekeepers and creating job opportunities in sales, distribution, and branding. As beekeeping continues to thrive, it fosters entrepreneurship and supports the development of small businesses within the industry. Additionally, government support and investment in beekeeping infrastructure and marketing initiatives can catalyze job creation and economic growth, particularly in rural areas where beekeeping often serves as a sustainable source of income. The study concluded that beekeeping contributes significantly to economic development by providing employment opportunities, promoting entrepreneurship, and stimulating local economies.

Table 13. Income level/year of the beekeepers of nyamagabe beekeeping cooperatives – economic development

	Frequencies	Percent
Between 0-200.000	25	11.6
Between 200.005-400.000	67	31.2
Between 400.005-800.000	83	38.6
Above 800.000	40	18.6

The Table 13 provides insights into the income levels per year of beekeepers within the Nyamagabe beekeeping cooperatives, categorized into four income brackets: between 0-200,000 Rwandan Francs, between 200,005-400,000 Rwandan Francs, between 400,005-800,000 Rwandan Francs, and above 800,000 Rwandan Francs. Each category is accompanied by its respective frequency and percentage. The data illustrates that the majority of beekeepers fall within the middle-income brackets, with 67 beekeepers (31.2%) earning between 200,005-400,000 Rwandan Francs annually and 83 beekeepers (38.6%) earning between 400,005-800,000 Rwandan Francs annually. This indicates a significant portion of beekeepers in the cooperatives are achieving moderate levels of income. Additionally, there is a noteworthy presence of beekeepers in the lower-income bracket, with 25 beekeepers (11.6%) earning between 0-200,000 Rwandan Francs annually, highlighting the need for support and interventions to improve their livelihoods. Conversely, 40 beekeepers (18.6%) are earning above 800,000 Rwandan Francs annually, indicating a smaller but still notable segment of beekeepers achieving higher levels of income, which could signify successful and potentially larger-scale operations. This data serves as a valuable tool for understanding the economic landscape of beekeeping within the

Nyamagabe community, guiding efforts towards promoting sustainable economic development and improving the livelihoods of beekeepers.

Conclusion

In conclusion, beekeeping cooperatives in Nyamagabe District play a vital role in the socio-economic development of communities around Nyungwe National Park. The cooperatives' activities, including beekeeping operations, income generation, and collaboration with NGOs, have contributed to poverty alleviation, rural development, and environmental conservation. The findings underscore the importance of beekeeping as a sustainable livelihood option and highlight the need for continued support and investment in beekeeping initiatives to further enhance the socio-economic well-being of the communities.

The findings underscore the significance of beekeeping as a catalyst for socio-economic development in communities around Nyungwe National Park. Moderate-scale beekeeping operations, coupled with supportive interventions and stakeholder engagement, have resulted in improved livelihoods, income generation, and social cohesion among beekeepers. The positive relationship between beekeeping practices and socio-economic development highlights the potential of beekeeping as a sustainable livelihood strategy for communities in the region.

The findings emphasize the crucial contribution of beekeeping cooperatives in supporting beekeepers and ensuring the success and sustainability of beekeeping ventures in Nyamagabe District. The perceived level and importance of cooperative support in hive management practices, market access facilitation, and beekeeping training underscore the pivotal role of cooperatives in driving socio-economic development within the community. These insights can inform policy and programmatic interventions aimed at further strengthening the support provided by beekeeping cooperatives and enhancing the socio-economic impact of beekeeping in communities around Nyungwe National Park.

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